BIOLOGICAL NOTES ON MEGACHILE CONCINNA SMITH IN ARIZONA[1]

(Hymenoptera: Megachildae)

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This paper discusses the life history and nesting habits of a leaf-cutter bee, *Megachile (Eutricharaea) concinna* Smith, in southern Arizona. A closely related species, *Megachile (Eutricharaea) rotundata* (Fabricius), is a useful pollinator of alfalfa in the Pacific Northwest and in the Intermountain Region. Biological observations of this species were reported by Stephen and Torchio (1961) and artificial nesting sites and their management by Stephen (1961 and 1962), and Bohart (1962).

Distribution

The distribution of *M. concinna* was discussed by Mitchell (1962:122): "Although *concinna* was described from the West Indies, it belongs to an Old World group and probably was introduced from Africa during the early part of the nineteenth century. It appeared in the United States after World War II and is now distributed from Florida and Alabama to Pennsylvania and Ohio in the East, and established as far west as California." In Arizona, *M. concinna,* determined by T. B. Mitchell, is distributed in the desert valley region of southern Arizona with a number of collections from the Yuma area, various locations in the Salt River Valley, around Tucson and single records from Patagonia and Bowie. This species has a long season of activity and adults were observed from mid-April to early November.

Plant Associations

The flowers that bees have been observed visiting are listed by Mitchell (1962) and include *Asclepias, Bidens, Melilotus* and *Polygonum*. The flowers from which bees have been collected in Arizona include: alfalfa, birds-foot treefoil, berseem clover, citrus, *Acacia, Heliotropium, Lepidium, Lippia, Onobrychis vicaefolia,* and *Senecio*. Leaves cut and used for nest construction were collected from alfalfa when the bees were working in cages over alfalfa. Due to the limited nesting activity observed outside of the cages, additional plant records are few, but it appeared as if leaf-cuttings from a number of different plants were used.

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Nesting Sites

M. concinna made nests in tubular holes, such as nail holes in wood, small holes in the mortar joints in brick walls, copper tubing, and the ears and folds of fertilizer sacks. In our experimental work bees nested in 3/16 to 1/4 inch holes drilled in wooden blocks, in milkshake straws (7/32-inch inside diameter) and also in milk straws (5/32-inch inside diameter), both black and white. During April, "trap nests" of blocks of wood with drilled holes and boxes of milk straws attached were hung up in a number of protected locations around Tucson and Yuma. The holes in the wooden blocks were used almost exclusively by two species of larger bees, *Chalicodoma (Chelostomoides) chilopsidis* Cockerell and *C. occidentalis* Fox (determined by T. B. Mitchell), which used resin for their cell construction. *Trypoxylon* wasps also nested in the holes in boards and in straws. Additional trap nests were put out in Tucson and Yuma during June but only a very few holes were utilized by *M. concinna.*

Cells

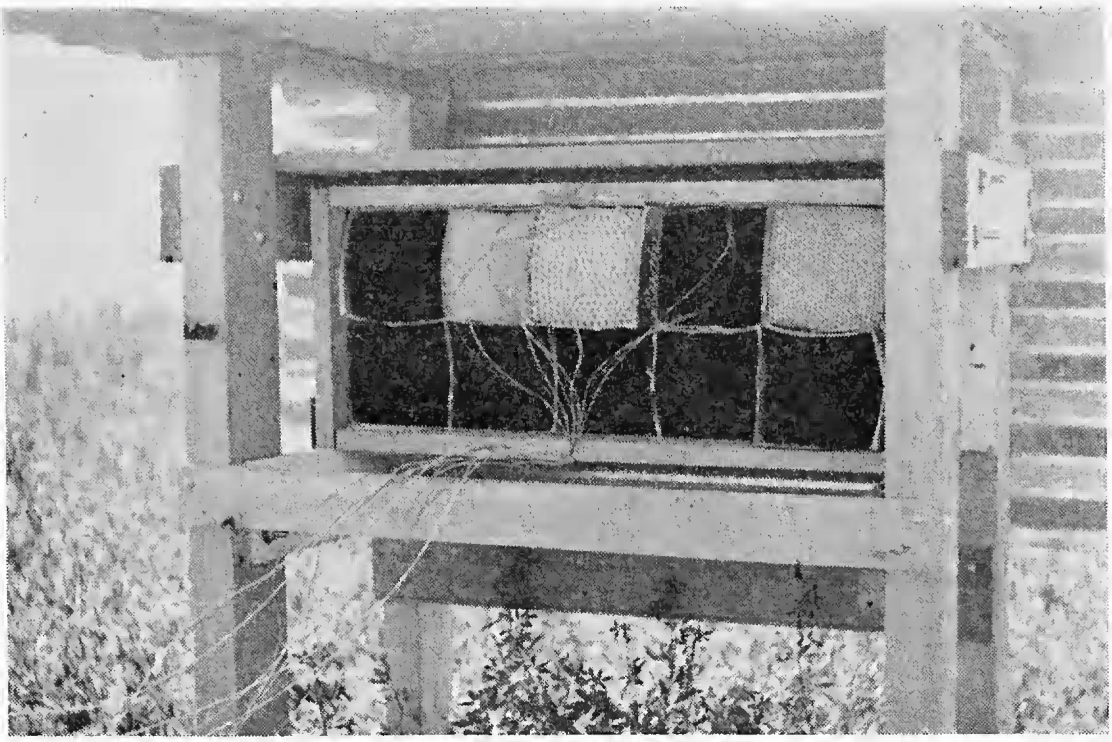
The structure of cells was determined by opening a number of nests made in milkshake straws. Sometimes we found that a space was left by the bees at the back of long straws, in which case a number of round leaf pieces were placed in as plugs before the first cell was started. The cells were formed with 2 to 4 round leaf pieces at the back end and 6 to 10 oblong pieces on the sides. In the long milkshake straws there were as many as 15 cells but usually fewer were constructed in a single straw. At the open end there was often an air space of from 10 to 80 mm between the last cell and an entrance plug made up of from 7 to 36 round leaf pieces. Sometimes entrance plugs were put in the ends of empty straws.

Adult Activity

Activity of the leaf-cutter bees was observed at a shaded nesting shelter placed at the edge of an alfalfa field at Tucson in early August. The bees spent the night in the wooden blocks and straws. They began their activity from 7 to 8 a.m., and sometimes spent up to 30 minutes during this period with their heads at the entrance of the straw before leaving. Later in the day the bees hesitated only a moment at the entrance before flying off.

The time required for a bee to collect a load of pollen varied considerably but the average time was between 10 and 20 minutes. The bee remained in the straw from 1 to 2 minutes depositing the pollen load. In the field the females tripped from 4 to 21 alfalfa flowers per minute, with an average of about ten flowers per minute. The bees tripped all of the flowers they visited. The number of pollen loads needed to complete a pollen ball was not determined, but one bee made at least 20 trips. After laying an egg on the surface of the completed pollen ball, the bee collected additional circular leaf pieces to close the end of the cell. The collection of leaf pieces in the alfalfa field required 1 to 2 minutes for each leaf piece. Towards 5 p.m., the activity of the bees became irregular. There was still some activity at 6:30 p.m. when observations were terminated.

The effectiveness of *M. concinna* as a pollinator of alfalfa was observed in large saran screen cages. Adult bees were collected from birds-foot treefoil and released in cages over alfalfa. Counts of tripped alfalfa flowers indicated that approximately 80 leaf-cutter bees were as effective as a small colony of honey bees.



EXPLANATION OF FIGURE

Fig. 1, front view of nest shade shelter with corrugated aluminum roof and with thermocouple wires in position for making temperature readings in the straws.

TEMPERATURE STUDIES

Bohart (1962) observed that the development of *M. rotundata* eggs and young larvae was limited by temperature in excess of 100°F. In southern Arizona the daily maximum temperature reaches 100°F and above during extended periods. Temperature readings were made in experimental nesting shelters constructed of different materials. Concurrently, laboratory studies were made to determine the effect of high temperatures on *M. concinna* eggs and young larvae.

Nest Shelters:—A basic nest shelter was constructed of a frame of 2x4's, four feet high, into which a wooden box holding 10 boxes of soda straws could be inserted. A layer of Celotex was put on top and at the back of the wooden box with a 3-inch air space between the Celotex and the experimental covering material on the top and back of the frame. The covering materials tested were corrugated aluminum, white painted half inch plywood, unpainted corrugated iron and white painted corrugated iron (Fig. 1).[2]

Temperature readings were made at hourly intervals with thermocouples on July 17 when the official maximum temperature reached 104°F. A comparison of the four types of shade materials with an unshaded structure indicated that the temperatures beneath the shades were 13 to 15 degrees cooler than the unshaded structure, in which the temperature reached 120°F. A variation of only 2 degrees between the different shade materials was not significant. There was also no difference between the temperatures in the soda straws in the top layers of the box and those in the center. The size and color of the straws did not affect the temperature either.

Laboratory Studies:—One-day-old *M. concinna* cells were collected from boxes of straws in cages with bees on alfalfa flowers. They were divided among three temperature cabinets at 85, 95 and 105°F, which had 43 to 55, 40 to 70 and 40 to 50 percent relative humidity, respectively. The cells were opened 6 days later and the mortality of the bees determined. At 85°F, there was no mortality in 34 cells and the bees were all in the larval stage. At 95°F, 3 cells of 40 contained dead bees and 63 percent of the bees were in the prepupal stage. At 105°F, the bees in all 40 cells were dead. They had died in either the egg or young larval stage.

To evaluate the effect of fluctuating temperatures, one-day-old *M. concinna* cells were put in three different temperature programs for six days. One group was at room temperature which rose to 90°F during the day from 1 to 5 p.m. and went down to 80°F at night. There was no mortality in the 17 cells observed at this temperature. In the second treatment the temperature was raised to 113°F from 12 noon to 2 p.m. and allowed to fluctuate with the room temperature for the rest of the time. There was no mortality in the 13 cells in this treatment. The third temperature program was 113°F for a four-hour period each afternoon. During the first afternoon the temperature rose to 117°F from 1 to 4 p.m. but for the next five days it was held at 113°F from 12 to 4 p.m. and at room temperature for the rest of the time. There was a single dead bee out of 18 but its death may have been caused by careless handling. At the time the cells were opened, 6 days after collection, the bees had developed to the prepupal stage and some individuals had spun cocoons. Adult bees emerged from the cells used in this experiment in from 21 to 26 days, with an average of 23 days from egg to adult.

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PARASITES

A small metallic-green parasite, *Tetrastichus megachilidis* Burks, determined by B. D. Burks, parasitized 20 percent of the *M. concinna* cells obtained in early July from cages on alfalfa at Tucson. From each parasitized cell there emerged 35 to 90 parasites, with an average of 53 per cell. Adult parasites were in evidence around all of the *M. concinna* nesting sites at Tucson during the remainder of the summer. The type locality for the parasite is near Phoenix, Arizona (Burks, 1963). No parasites were observed in or around trap nests in the Yuma area in 1962.

Examinations of 32 straws with 266 cells from Tucson in mid-September revealed a parasitism of 42 percent and indicated that the parasite attacked the first-made or innermost cells. In this group of straws, 93 percent of the first cells were parasitized, while 48, 38, 16, 10, 7, 4, and 0 percent of the second through the eighth cells, respectively, were parasitized. In part of this series, female bees were developing in all the innermost cells, including the second, third and fourth cells, so the parasitism by *Tetrastichus* was almost exclusively in cells preducing female *M. concinna.*

DISCUSSION

Megachile concinna is distributed throughout the alfalfa seed producing areas of southern Arizona. The natural nesting sites at present appear to be scattered. Numerous artificial nesting holes in different materials placed in many locations attracted only a few bees. Concentrated nesting in artificial nesting structures is necessary for the effective use of leaf-cutter bees for alfalfa pollination. However, concentration may favor the chalcid parasite, *Tetrastichus,* which apparently has a very high reproductive potential. It is possible that the tendency of *concinna* to disperse their nests may be a factor which enables the bees to survive in the presence of the parasite. The harmful effect of high temperatures in the desert areas may be reduced in the natural nesting sites as the nests are constructed in holes in various structures that provide shade. Mortality from high temperatures can be avoided in artificial shelters by providing shade and air circulation. The reluctance of the bees to utilize artificial holes for nesting and the presence of the parasite appear to indicate that *M. concinna* is not a potentially effective pollinator of alfalfa in southern Arizona.

LITERATURE CITED

BOHART, G. E.

1962. How to manage the alfalfa leaf-cutting bee (Megachile rotundata Fabr.) for alfalfa pollination. Utah Agr. Expt. Sta. Circ. 144.

BURKS, B. D.

1963. Ten new reared species of *Tetrastichus.* (Hymenoptera, Eulophidae). Proc. Biol. Soc. Washington, 76:47-58.

MITCHELL, T. B.

1962. Bees of the Eastern United States, Volume II. North Carolina Expt. Sta. Tech. Bul. 152.

STEPHEN, W. P.

1961. Artificial nesting sites for the propagation of the leaf-cutter bee, *Megachile (Eutricharaea) rotundata,* for alfalfa pollination. Jour. Econ. Ent., 54:989-993.

1962. Propagation of the leaf-cutter bee for alfalfa seed production. Oregon Agr. Expt. Sta. Bul. 586.

STEPHEN, W. P. AND P. F. TORCHIO

1961. Biological notes on the leaf-cutter bee, *Megachile (Eutricharaea) rotundata* (Fabricius). Pan-Pacific Ent., 37: 85-93.

MEETING NOTICE

The first International Conference on Acarology will be held September 2-7, 1963 at Colorado State University, Fort Collins, Colorado.